CLAIMS

1. An improved multiple sub-band processing system having a first M-channel synthesis filter bank followed by a second L-channel analysis filter bank, for the case of L=K*M where K is an integer, L is a down-sampling factor of the second analysis filter bank, and M is an up-sampling factor of the first synthesis filter bank, the improvement comprising:

combining the first synthesis filter bank with the second analysis filter bank in accordance with the equation:

$$Y_k(z) = H^1_{p,k(I*M-m)mod(k*M)}(z)*(\downarrow K)*z^{-I} * F_{p,m}(z)*X_m(z).$$

2. The improved multiple sub-band processing system of claim 1, wherein the combined filter bank includes M, K-output demultiplexers operating at a rate of f_{clock}.

3. The improved sub-band processing system of claim 2, further comprising two low frequency clock distribution lines f_{clock} and f_{clock}/K.

4. In a multiple sub-band processing system having a first M-channel synthesis filter bank followed by a second L-channel analysis filter bank, for the case of L=K*M where L is a down-sampling factor of the second analysis filter bank and M is an up-sampling factor of the first synthesis filter bank, and wherein the first synthesis filter bank is combined with the second analysis filter bank, the first synthesis filter bank comprising:

M polyphase filters, wherein the m^{th} polyphase filter receives an input signal $X_m(z)$ and generates a filtered output signal;

K down-samplers connected to the m^{th} polyphase filter, by way of a delay circuit, that down-sample by a factor K the filtered output signal; and

an equivalent filter that operates in accordance with

with the equation $Y_k(z) = H^1_{p,k(I*M-m)mod(k*M)}(z)*(\downarrow K)*z^{-I} * F_{p,m}(z)*X_m(z)$

to generate K polyphase outputs.

5. An improved multiple sub-band processing system having a first M-channel synthesis filter bank followed by a second L-channel analysis filter bank, for the case of M=K*L, where K is an integer, L is a down-sampling factor of the second analysis filter bank, and M is an up-sampling factor of the first synthesis filter bank, the improvement comprising:

combining the first synthesis filter bank with the second analysis filter bank in accordance with the equation:

$$Y_k(z) = H_{p,k}(z) \times \sum_{I=0}^{K-1} z^{-I} \times (\uparrow K) \times F^1_{p,(I\times L-k)\bmod(K\times L)}(z) \times X_{(I\times L-k)\bmod(K\times L)}(z)$$

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6. The improved multiple sub-band processing system of claim 5, wherein the combined filter bank includes L, K- input multiplexers operating at a rate of $K*f_{clock}$.

7. The improved sub-band processing system of claim 6, further comprising two low frequency clock distribution lines f_{clock} and f_{clock}*K.

8. In a multiple sub-band processing system having a first M-channel synthesis filter bank followed by a second L-channel analysis filter bank for the case of M=K*L, where K is an integer, L is a down-sampling factor of the second analysis filter bank, and M is an up-sampling factor of the first synthesis filter bank, and wherein the first synthesis filter bank is combined with the second analysis filter bank, the combined filter bank structure comprising:

K equivalent filters receiving K inputs to generate K intermediate filtered signals.

9. The combined filter bank structure of claim 8, wherein the K intermediate filtered signals are up-sampled by factor K and subsequently provided to a delay and sum circuit to generate an output signal that is input to a k^{th} polyphase filter of the second analysis filter bank.

10. The combined filter bank structure of claim 8, wherein the k^{th} polyphase filter generates the polyphase filtered output in accordance with the equation:

$$Y_k(z) = H_{p,k}(z) \times \sum_{I=0}^{K-1} z^{-I} \times (\uparrow K) \times F^1_{p,(I\times L-k)\bmod(K\times L)}(z) \times X_{(I\times L-k)\bmod(K\times L)}(z)$$

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